What is claimed is:

[Claim 1] An apparatus for manipulating the temperature of a sample used in focused ion beam FIB processing, comprising:

a base member;
a thermoelectric module disposed over the base member; and
a sample mounted on a mounting surface of the thermoelectric module;
wherein said thermoelectric module is configured so as to reduce the temperature of said sample with respect to an ambient FIB tool temperature.

[Claim 2] The apparatus of claim 1, wherein said thermoelectric module further comprises a Peltier device.

[Claim 3] The apparatus of claim 2, wherein said thermoelectric module is configured to draw heat from the sample and exhaust said heat through said base member.

[Claim 4] The apparatus of claim 1, wherein said thermoelectric module is electrically coupled to a current source through an electrical connector disposed through a vacuum chamber wall of an FIB tool.

[Claim 5] The apparatus of claim 1, further comprising a thermal ballast module mounted on said base member.

[Claim 6] The apparatus of claim 5, wherein said thermal ballast module is disposed adjacent to said thermoelectric module.

[Claim 7] The apparatus of claim 5, wherein said thermoelectric module in mounted on said thermal ballast module.

[Claim 8] The apparatus of claim 5, wherein said thermal ballast module further comprises:

a sealed, hollow vessel constructed from a material having a high thermal conductivity; and
a plurality of internal fins configured for facilitating heat transfer from said base member to an internal ballast material, said internal ballast material including a high heat-capacity material.

[Claim 9] The apparatus of claim 4, further comprising a plurality of cooling ports within said base member, said cooling ports for receiving a cooling medium circulated therethrough supplied by a cooling supply line.

[Claim 10] The apparatus of claim 9, wherein said cooling supply line is coupled to a cooling medium connector disposed through a vacuum chamber wall of an FIB tool.

[Claim 11] A method for implementing focused ion beam (FIB) processing, the method comprising:

mounting a sample on a mounting surface of an FIB tool, said mounting surface including a thermoelectric element;
controlling said thermoelectric element so as to reduce the temperature of said sample with respect to an ambient FIB tool temperature; and
applying an FIB to said sample.

[Claim 12] The method of claim 11, wherein said thermoelectric element further comprises a Peltier device.

[Claim 13] The method of claim 11, further comprising utilizing said FIB to deposit a layer on said sample.

[Claim 14] The method of claim 13, wherein said layer comprises an insulating layer deposited using a silicon-bearing precursor.

[Claim 15] The method of claim 14, wherein said insulating layer comprises SiO_2.

[Claim 16] The method of claim 13, wherein said layer comprises an insulating layer deposited using at least one or more of the following precursor combinations: tetramethylcyclotetrasiloxane (TMCTS) with no oxidizing agent, tetraethylorthosilicate (TEOS) with O_2, TMCTS with H_2O, TEOS with O_2, TEOS with O_2, TEOS with H_2O.

[Claim 17] The method of claim 13, wherein said layer comprises a metal layer deposited using at least one or more of the following precursor combinations: tungsten hexacarbonyl ($W(CO)_6$), methylcyclopentadienyl (trimethyl) platinum (V), any of the beta-diketonate copper (II) complexes, and any of the Lewis-base copper (I) beta-diketonate complexes.

[Claim 18] The method of claim 11, further comprising utilizing said FIB in a removal process to remove material from said sample.

[Claim 19] The method of claim 18, wherein said removal process further comprises at least one of: milling silicon using a xenon difluoride (XeF_2) precursor, milling SiO_2 using an XeF_2 precursor, milling tungsten using an XeF_2 precursor, milling SiCOH type low-k dielectric materials using an XeF_2 precursor, milling chromium using an XeF_2 precursor, milling organic materials and polymers using an XeF_2 precursor, milling copper using an XeF_2 precursor, milling silicon using a Br_2 precursor, and milling aluminum using a Br_2 precursor.